

ANSWERS: Crystal ball questions on Comparing and contrasting properties of substances

melting point
and
solubility in water
and
conductivity

A is a molecular substance with strong covalent bonds between atoms and weak intermolecular forces between molecules.

B is an ionic substance with strong ionic bonds between oppositely charged ions

C is a metallic substance

A is a molecular substance made up of molecules. There are weak intermolecular forces holding the molecules together and:

- (for melting point) require only a small amount of energy to overcome them meaning Br₂ has a low melting point
- (for solubility) the attraction of the polar water molecules is not sufficient to separate the non-polar molecules of A, meaning A is not soluble in water.
- (for conductivity) there are no free electrons or charged particles to carry a charge so A doesn't conduct electricity

B is an ionic solid. It consists of a 3-D lattice of positive ions and negative ions and the ions are held together by strong ionic bonds.

- (for melting point) require a large amount of energy to overcome the ionic bonds to separate the ions, so B has a high melting point
- (for solubility) the attraction of the water molecules is sufficient to separate the bromine molecules, meaning B is soluble in water.
- (for conductivity) there are positively and negatively charged ions to carry a charge so B doesn't conduct electricity

C consists of atoms held together in a 3-D lattice by metallic bonding, in which valence electrons are attracted to the nuclei of neighbouring atoms.

- (for melting point) requires a high amount of energy to overcome the metallic bonds meaning C has a high melting point
- (for solubility) C is not soluble in water, as the metallic bonds are too strong to be broken by the attraction to the water molecules.
- (for conductivity) there are delocalised electrons free to move and carry a charge so C conducts electricity

2) melting and boiling points

PO₂

Exists as molecules. Weak van der Waals forces exist between the molecules. As the intermolecular /van der Waals forces between molecules are weak these are easily overcome hence little energy is required to separate the molecules [therefore has a low mp /sublimes at -78°C].

QO₂

Exists as 3-D covalent network. Strong covalent bonds hold the atoms together in a 3-D arrangement. As the covalent bonds between atoms are strong they require a lot of energy to overcome and separate atoms so the melting point is very high. Also since the strong covalent bonds hold the atoms firmly in the 3-D structure, the solid is very hard.

3) melting and boiling points and state at room temperature

<p>NaF, NaCl, NaBr and NaI are all ionic substances</p> <p>They consists of a 3-D lattice of positive Na⁺ ions and negative F⁻ or Cl⁻ or Br⁻ or I⁻ ions and the ions are held together by strong ionic bonds.</p> <p>A large amount of energy to overcome the ionic bonds to separate the ions, so sodium halides have high melting points and are solids at room temperature. The ionic bonds are directional so the solids form a crystalline structure.</p>	<p>F₂, Cl₂, Br₂ and I₂ are all molecular substances</p> <p>They consist of atoms joined by strong covalent bonds (eg F atom covalently bonded to another F atoms) forming a molecule. There are weak intermolecular forces holding the molecules together.</p> <p>The halogens all have low melting points as only a small amount of energy is required to overcome the weak intermolecular forces.</p> <p>Iodine is in a solid state at room temperature because the iodine atom has a far greater number of electrons than fluorine or chlorine so there is an increase in the number of intermolecular forces between I₂ molecules, resulting in a solid state at room temperature</p> <p>Bromine is in a liquid state at room temperature because the bromine atom also has a greater number of electrons than fluorine or chlorine so there is an increase in the number of intermolecular forces between Br₂ molecules, resulting in a liquid state at room temperature. There are fewer intermolecular forces between bromine molecular than iodine molecules because bromine few fewer overall electrons than iodine thus forming fewer intermolecular forces.</p>
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hardness and lubricant

<p>diamond</p> <p>Diamond is made of carbon atoms. Each carbon atom is covalently bonded to 4 other C atoms in a tetrahedral 3D arrangement, which forms a covalent network solid. The covalent bonds between the carbon atoms are very strong and require a large amount of energy to break them hence diamond is a very hard substance.</p>	<p>Graphite</p> <p>Graphite consists of C atoms each covalently bonded to three other C atoms in a 2-D or layered arrangement with weak intermolecular forces of attraction between the layers or sheets. However in graphite, although the bonds between the covalently bonded carbon atoms in the layers are strong, the forces between the layers are weak, resulting in the layers sliding over each other. Therefore graphite is a soft substance and is used as a lubricant.</p>
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